CLAIMS

1. A system for assessing stability in a boom lift vehicle including a boom, a boom pivot, a main lift cylinder coupled with the boom, a main lift cylinder pivot, and vehicle driving components, the system comprising:

a first force sensor pin installed in the boom pivot, the first force sensor pin detecting force components acting thereon via the boom pivot along two perpendicular axes;

a second force sensor pin installed in the main lift cylinder pivot, the second force sensor pin detecting force components acting thereon via the main lift cylinder along two perpendicular axes; and

a control system communicating with the vehicle driving components and the first and second force sensor pins, the control system assessing boom lift vehicle stability based on the force components acting on the first and second force sensor pins and controlling the vehicle driving components based on boom lift vehicle stability.

2. A system according to claim 1, wherein the boom lift vehicle further includes a boom rest and a load cell coupled with the boom rest, and wherein the control system determines boom lift vehicle stability based on a destabilizing moment (M), such that:

$$M = -Y_b B_h - Y_C C_h + X_b B_V + X_C C_V - X_r F,$$

where X_b, Y_b, X_c and Y_c are horizontal and vertical distances from the first and second force sensor pins, respectively, to a point around which the moment is determined, X_r is a horizontal distance from the load cell to the point around which the moment is determined, B_v and B_h are vertical and horizontal force components for the first force sensor pin, respectively, C_v and C_h are vertical and horizontal force components for the second force sensor pin, respectively, and F is a force on the load cell.

3. A system according to claim 2, wherein the control system determines boom lift vehicle stability based on a destabilizing moment (M), such that:

$M = M_O = -Y_b B_h - Y_C C_h + X_b B_V + X_C C_V$, when the boom is not on the boom rest, and

$M = M_{O'} = -(Y_b - Y_r)B_h - (Y_C - Y_r)C_h + (X_b + X_r)B_V + (X_C + X_r)C_V$, when the boom is on the boom rest

4. A system according to claim 3, wherein the control system determines whether the boom is on the boom rest such that if $\arctan\left(\frac{C_V}{C_h}\right) \neq \alpha_r$, then the boom is not on the boom rest, where α_r is a reference angle of the main lift cylinder achieved when the boom is on the boom rest.

5. A system according to claim 3, wherein the control system determines whether the boom is on the boom rest such that if a vector sum of horizontal forces $B_h + C_h = 0$ or less than a predetermined value, then the boom is not on the boom rest.

6. A system according to claim 1, wherein the control system effects a continuous rated capacity of the boom lift vehicle.

7. A system according to claim 1, wherein the control system monitors a load on the boom lift vehicle via the force components acting on the first and second force sensor pins.

8. A system according to claim 1, wherein the control system determines boom angle based on the force components acting on the first and second force sensor pins.

9. A system according to claim 8, wherein the control system determines boom angle (θ) such that

$$\theta = \arctan\left[\frac{kC_V - pC_h \pm \sqrt{(C_V^2 + C_h^2)(k^2 + p^2) + (mC_V + rC_h)^2}}{(m+p)C_V + (r+k)C_h}\right],$$

where k,m,p and r are geometrical design parameters, and C_V and C_h are vertical and horizontal force components for the second force sensor pin, respectively.

10. A system according to claim 1, wherein the control system determines boom structural load conditions via the force components acting on the first and second force sensor pins, the control system controlling operation of the driving components based on the structural load conditions.

11. A system according to claim 1, wherein each of the first and second force sensor pins comprises an internal housing containing associated electronics therein including a pin microprocessor, the pin microprocessor being configured to effect filtering and amplification of the detected force components and to store calibration factors and pin identity information.

12. A system according to claim 1, further comprising an additional force sensor pin for each moving part attachment to non-moving turntable.

13. A system for assessing stability in a boom lift vehicle including a boom, a boom pivot, a main lift cylinder coupled with the boom, a main lift cylinder pivot, and vehicle driving components, the system comprising:

means for detecting force components acting on the boom pivot along two perpendicular axes;

means for detecting force components acting on the main lift cylinder pivot along two perpendicular axes; and

means for assessing boom lift vehicle stability based on the force components and for controlling the vehicle driving components based on boom lift vehicle stability.

14. A method for assessing stability in a boom lift vehicle including a boom, a boom pivot, a main lift cylinder coupled with the boom, a main lift cylinder pivot, and vehicle driving components, the method comprising:

(a) detecting force components acting on the boom pivot along two perpendicular axes;

(b) detecting force components acting on the main lift cylinder pivot along two perpendicular axes; and

(c) assessing boom lift vehicle stability based on the detected force components and controlling the vehicle driving components based on boom lift vehicle stability.

15. A method according to claim 14, wherein step (c) is practiced by assessing both forward and backward stability of the boom lift vehicle based on the detected force components.

16. A method according to claim 14, wherein the boom lift vehicle further includes a boom rest and a load cell coupled with the boom rest, and wherein step (c) is practiced by determining boom lift vehicle stability based on a destabilizing moment (M), such that:

$M = -Y_b B_h - Y_C C_h + X_b B_V + X_C C_V - X_r F$, where X_b, Y_b, X_c and Y_c are horizontal and vertical distances from the first and second force sensor pins, respectively, to a point around which the moment is determined, X_r is a horizontal distance from the load cell to the point around which the moment is determined, B_v and B_h are vertical and horizontal force components for the first force sensor pin, respectively C_v and C_h are vertical and horizontal force components for the second force sensor pin, respectively, and F is a force on the load cell.

17. A system according to claim 16, wherein step (c) is practiced by determining boom lift vehicle stability based on a destabilizing moment (M), such that:

$M = M_O = -Y_b B_h - Y_C C_h + X_b B_V + X_C C_V$, when the boom is not on the boom rest, and

$M = M_{O'} = -(Y_b - Y_r)B_h - (Y_C - Y_r)C_h + (X_b + X_r)B_V + (X_C + X_r)C_V$, when the boom is on the boom rest.

18. A method according to claim 17, wherein step (c) further comprises determining whether the boom is on the boom rest such that if $\arctan\left(\frac{C_V}{C_h}\right) \neq \alpha_r$, then the boom is not on the boom rest, where α_r is a reference angle of the main lift cylinder achieved when the boom is on the boom rest.

19. A system according to claim 17, wherein step (c) further comprises determining whether the boom is on the boom rest such that if a vector sum of horizontal forces $B_h + C_h = 0$ or less than a predetermined value, then the boom is not on the boom rest.

20. A method according to claim 14, further comprising effecting a continuous rated capacity of the boom lift vehicle.

21. A method according to claim 14, further comprising monitoring a load on the boom lift vehicle via the detected force components.

22. A method according to claim 14, further comprising determining boom angle based on the detected force components.

23. A method according to claim 22, wherein the boom angle (θ) is determined such that

$$\theta = \arctan\left[\frac{kC_V - pC_h \pm \sqrt{\left(C_V^2 + C_h^2\right)\left(k^2 + p^2\right) + \left(mC_V + rC_h\right)^2}}{(m+p)C_V + (r+k)C_h}\right],$$

where k, m, p, r are geometrical parameters, and C_V and C_h are vertical and horizontal force components for the second force sensor pin, respectively.

24. A method according to claim 14, further comprising determining structural load conditions via the detected force components, and controlling operation of the driving components based on the structural load conditions.